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EMBRYOLOGY.[1]

THE STRUCTURE OF THE HUMAN SPERMATOZOON.—Any new light which is thrown upon the structure of the sexual elements by the aid of more refined methods of research, will be welcomed in view of the possible bearings which such information may have upon questions of inheritance. That variations in the structure of the male elements do occur as abnormalities seems to be established by the researches of E. M. Nelson [2], who finds that not only do they vary in the number of heads, but also in the number of tails and even as to the number of the nuclei; forms were also met with which were joined together in pairs by a band. Those familiar with Selenka's work on the Opossum will recall in this connection the singular fact recorded by that embryologist as to the double nature of the fresh spermatozoa of *Didelphys virginiana.*

The most interesting facts, however, which Mr. Nelson records as the result of his studies, with the aid of the new apochromatic objectives of Zeiss, relate to the details of structure of the human male element.

The head, which has always been figured as a simple, somewhat flattened pyriform body, according to this last observer, is rather complex when studied by the aid of better appliances. It is rather obovate in outline from the broad side, but when viewed edgewise it is seen to be curved upon itself, so that it bears a resemblance to an oblong meniscus lens.

Furthermore, this observer gives names to its parts. The anterior portion containing the nucleus, he calls the *spore*, and at its extreme anterior pole it bears an excessively minute *filament* as he names it, which is hardly as long as the spore itself. He suggests that this is a sort of feeler or tentacle by means of which the spermatozoon finds its way into the pore in the ovum which serves for the micropyle.

The flattened and curved flagellum-bearing spore is joined to or rests in what Nelson calls the *cup* which corresponds to the swollen basal part of the head as usually figured.

Then succeeds a delicate cycle of processes just around the base of the cup where the latter joins what Nelson calls the *stem*, which answers to the "middle piece" of authors. This delicate cycle of bluntly rounded processes he calls the *calyx.*

Next follows the *stem* or "middle piece" which at its posterior extremity is slightly swollen. This swollen posterior extremity of the stem and the anterior end of the tail there occurs a constriction which has been previously noticed by Nelson, and to which he gives

[1] Edited by Prof. John A. Ryder, University of Pennsylvania, Philadelphia.

[2] On the human spermatozoon, Journ. Quekett Microscop. Club. Ser. II, Vol. III, No. 23. Jan., 1889, pp. 310-314.

the appropriate name of *joint.* It seems, in fact, as if such were its nature, as a very short refringent and dark band of substance here joins the stem and tail together. This band is so much narrower than the stem or tail that it appears as if there were a deep notch on either side of the tail portion of the spermatozoon at this point.

Immediately behind the joint, the flagelliform tail is continued as that tapering organ[1] familiar to all histologists since the time of Leeuwenhoek.

The structure of the spermatozoon is therefore more complex than is usually supposed, and the following eight parts may be distinguished, beginning at the anterior extremity :

Filament, spore, cup, calyx, stem, joint, tail.

The following measurements are given :

Head (spore and cup) long	$\frac{1}{4250}$	in.	5.9 μ
" " broad	$\frac{1}{7500}$	"	3.4 μ
Stem long	$\frac{1}{5700}$	"	4.4 μ
Tail from joint to tip	$\frac{1}{500}$	"	.05 *mm.*
Total, head, stem and tail	$\frac{1}{425}$	"	.06 *mm.*

From what has preceded it is clear that there is great capacity for variation. Further, it is probable that this high degree of complexity signifies that a very considerable part of the spermatozoon is of secondary importance, or is rather only accessory to the act of fertilization or the formation of an öosperm. The already remarkable results of those investigators who have occupied themselves with the study of the phenomena of fertilization, must undoubtedly be modified when the subject is viewed from the basis of a renewed study of the structure and function of the spermatozoon at all phases of the process of its union with the ovum. May it not be that some important parts of the process of union have escaped observation in virtue of the optical difficulties which are involved? The consequences of fertilization as the result of union with abnormal spermatozoa is also worthy of consideration, not only from a purely scientific standpoint, but also on account of the possible light it might throw upon possible abnormalities so provoked, which eventuate in disease and deformity. Truly, to those who are familiar with the great number of forms assumed by the male element throughout the animal kingdom, and the very diverse conditions under which fertilization occurs, it seems as if Du Bois Reymond's reproach—*Ignorabimus*—may here remain true.

[1] It may possibly be of advantage to use the word *organula* here instead of organ, following a suggestion of Möbius. Functionally differentiated multicellular aggregates in multicellular forms or metazoa are in this sense organs, while for functionally differentiated portions of unicellular organisms or for such differentiated portions of the unicellular germ-elements of metazoa the diminutive—*organula*—is appropriate.